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COUNTER SYSTEM USING MICROCONTROLLER FOR VISITOR

NUR FARAHIN BINTI ASA @ ESA

A thesis submitted in partial fulfilment of
the requirements for the award of the
degree of Bachelor of Engineering (Electrical-Power)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

JULY 2012

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This thesis is dedicated to my loving parents, always be my inspiration. You are the reason I step forward to this stage.

To teammate, my beloved friends, I will never forget your support.

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"Thank You.."

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Alhamdulillah. In the name of Allah, the Most Compassionate, the Most Merciful. Praise be to Him, the Lord of the universe. Blessing and solution of peace to Holy Prophet Muhammad (peace be upon him) and his companion and those who follow him as upholding the cause of the right religion.

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ABSTRACT

Nowadays, people often waste energy without realizing it. Home automation concept had been introduced to save power consumption. A counter system circuit was designed and set up to turn on or off the lights. This system is useful when someone in a room forgot to turn off the light when they leave only when nobody left in the room. Moreover, this device can be used to measure the number and direction of people traversing a certain passage or entrance. So, the counter system can count visitor pass through in a room. It turns on the light when the first visitor enters the room while it will turn off the lighting system when the last person leaves the room. In addition, it also can measure the height of the visitor. However, this device only limited with a room which provide an entrance only. The system uses microcontroller with PIC 18F452 and displayed at LCD display. Microcontroller use microC programming and this program consider limited probabilities but can be replacing with improved programming. In addition, system comes with sensor as input and relay as the output. The sensor and relay is responsible to detect visitor and control the lighting system. This concept can be further utilized by the hotels or building management to control their lights in their units effectively. Therefore the power consumption can be managed and reduce the emission of green house gases indirectly. Several assumptions and probabilities were made when setting up this prototype system and future improvement and research of this work also been studied.

ABSTRAK

Pada masa kini, manusia sering membazirkan tenaga tanpa disedari. Sistem automatik telah diperkenalkan untuk menjimatkan penggunaan kuasa. Litar sistem mengira telah direka bentuk untuk menghidupkan dan mematikan lampu. Sistem ini amat berguna apabila seseorang di dalam bilik lupa untuk mematikan lampu apabila mereka keluar dan apabila tiada siapa yang ada di dalam bilik. Selain itu, peranti ini boleh digunakan untuk mengukur bilangan dan hala tuju mereka yang melalui laluan tertentu atau pintu masuk. Jadi, sistem pengira boleh mengira bilangan pelawat yang masuk atau keluar dari bilik. Ia menghidupkan cahaya apabila pengunjung pertama memasuki bilik manakala akan mematikan sistem pencahayaan apabila orang yang terakhir meninggalkan bilik. Di samping itu, ia juga boleh mengukur ketinggian pengunjung. Walau bagaimanapun, peranti ini hanya terhad kepada sebuah bilik yang menyediakan satu pintu masuk dan satu pintu keluar sahaja. Sistem ini menggunakan "microcontroller" dan PIC 18F452, hasil akan dipaparkan di paparan LCD. "Microcontroller" menggunakan pengaturcaraan microC dan program ini mempertimbangkan kebarangkalian yang terhad tetapi boleh diperbaiki dengan pengaturcaraan yang lebih baik. Di samping itu, sistem ini dilengkapi dengan sensor sebagai input dan geganti sebagai output. Sensor dan geganti bertanggungjawab untuk mengesan pelawat dan mengawal sistem pencahayaan. Konsep ini boleh digunakan di hotel atau pengurusan bangunan untuk mengawal sistem pencahayaan dengan lebih berkesan. Oleh itu, penggunaan kuasa boleh diuruskan dan mengurangkan pelepasan gas rumah hijau secara tidak langsung. Beberapa andaian dan kebarangkalian dibuat semasa merekabentuk sistem prototaip dan pembaikan dan penyelidikan projek ini juga dikaji sepenuhnya.

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LIST OF ABBREVIATIONS

ADC	-	Analog Digital Converter
A/D	-	Analog to Digital
FKE	-	Fakulti Kejuruteraan Elektrik
UART	-	Universal Asynchronous Receiver/Transmitter
EEPROM	-	Electronically Erasable Programmable Read Only Memory
AUSART	-	Addressable Universal Asynchronous Receiver Transmitter
SFR	-	Special Faction Register
GPR	-	General Purpose Register
CMOS	-	Complementary metal–oxide–semiconductor
ICD	-	Implantable Cardioverter-Defibrillator
PWM	-	Pulse-width modulation
USB	-	Universal Serial Bus
ICSP	-	In Circuit Serial Programming

PC	-	Personal Computer
MCU	-	Multipoint Control Unit
IR	-	Infrared
I/O	-	Input / Output
LED	-	Light Emitting Diode
PIC	-	Peripheral Interface Controller
RAM	-	Random Access Memory
COFF	-	Common Object File Format
IDE	-	Integrated Development Environment
ANSI	-	American National Standards Institute
ROM	-	Read Only Memory
LDR	-	Light Dependent Resistor
CPU	-	Central Processor Unit
PDIP	-	Programmed Dialogue with Interactive Programs
LCD	-	Liquid Crystal Display
IC	-	Integrated Circuit

NO	-	Normally Open
NC	-	Normally Close

LIST OF SYMBOLS

cm	-	Centimeter
Hz	-	Hertz
MHz	-	Mega Hertz
uF	-	Mikro Farad
V	-	Volt
KB	-	Kilo Byte

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

In a public place such as shopping malls and cinemas, data on the number of visitor is frequently needed for marketing research or statistic purposes. Usually the counting process is done manually by the officers who guard the entrance. If this process is done for a long period of time, it will be prone to human errors. Same goes to a room such as laboratory, main hall, mosque or bedroom. A counter can be implemented to save energy by a specific system. For instance, lighting system is one of the major problems nowadays which is wasted because of human negligence. To overcome this problem, a system which is able to count automatically should be developed. In this new modern technology, new design and new creation had been made to save power consumption and energy. Various types of system and development improved. Power electronics technology uses electronic circuits to convert and control electric energy with optimum efficiency. Today, this technology is part of most electrically powered machines and devices. Power electronics technology also the key to increasing both the amount of electric power transmitted over the grid and the efficiency of power use. Moreover, centre researchers have made significant contributions in three areas critical to power electronics evolution: powering of a new generation of microprocessors; developing technologies for

integration of power electronics components, such as circuits and sensors; and using the integrated components for standardized methods of assembling power converters, which are still custom-designed [23].

As human keep wasting energy, these problems will never solved only if a new system designed to overcome this problem. In the aspect of energy conversion thinking, a basic start such as lighting system which people consume the most can be reduces by a few ideas. People always enter and leave a room such as bedroom, hall, laboratory, classroom without notice the lighting system stay on for a long time with nobody present in the room. A system can be designed so that when the room is empty, the lighting system can be automatically off. So from this idea, this will save electricity use for a building, saving cost and energy at the same time. This system should include sensor and relay. A sensor or also called detector is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument [5]. A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used [6]. A sensor will detect visitor so that it will trigger the relay to turn off and turn on the lighting system. This type of system had been use widely in many building, many places and country. Even a street lamp uses this method for energy conversion. This type of method will lead to power saving energy and thus become the one way to overcome the problem of shortage of power supply.

1.2 PROBLEM STATEMENT

A building in a company or university constantly use energy more than needed. This is because the resident did not alert to save power consumption. A

lighting system in laboratory at Faculty Kejuruteraan Elektrik (FKE) , Universiti Teknologi Malaysia always been detected did not turn off most of the night and caused the increase in electricity bill and energy wasting. So, one of the method can be use to solve this problem is to apply the counter system for visitor using microcontroller.

A counter system can be design in many ways such as combination of gate logic and microcontroller. Gate logic is simple and easy but this feature difficult to varied and becomes complex if the system needs more improvement in requirements. But, by the using of microcontroller, a system can be more complex but easy to design. This system will be installed in a laboratory which focused on the main door. This laboratory in FKE only use one way to in and out and so that, this system is suitable for this purpose. A sensor will be use to detect a person enter and out from the laboratory door and send signal to microcontroller. This microcontroller will count up and down based on the programming that been embedded on the PIC. A LCD display will inform the total occupant inside the laboratory and at the same time will display the counting data when a person enter or leave the room.

1.3 OBJECTIVES

This project is carried out to reduce energy wasting by residents in faculty by designing a prototype system with simple features. The objective of this project:

i. To design a system that will automatically control the lighting system
ii. To differentiate whether a visitor enter or leave the room and consider the probabilities using counter system
iii. To display the total visitor present in the laboratory and display the height of the visitor

iv. To develop a programming for microcontroller to count up and down visitor traversing a certain passage or entrance which in this case is the FKE laboratory
v. This system can calculate height of the visitor

1.4 SCOPE

This project is mainly concerned to design a counter that will count visitor and control the lighting system of a room or hall. Consequently, this system will avoid people wasting energy when they forgot to turn off the light. However, there are a few limitations on this project.

There are several scopes of the development of counter system for visitor using microcontroller that is:

i) Visitor cannot stay in between the sensor for more than 50ms
ii) SK40C will be used to run the program IC PIC 18F452 is chosen as the processor to store the program
iii) The developed system that count visitor which enter and leave the room, display total occupant inside the room and calculate the height of a visitor
iv) Implement two IR proximity sensors (GP2YOA21YK).
v) Identifying the counter process (count up or countdown)
vi) Single entrance and single exit room

‘

1.5 THESIS OUTLINE

This thesis consists of five chapters. In first chapter, it gives an overview with commence on introduction and background of the project, problem statement, and objectives.

Chapter Two discusses on the literature review of the system which includes the overall device used in this project. For this part, it gives the idea on counter, microcontroller and briefing about tool. In addition, the related work from previous project which is similar also included.

Chapter Three presents the methodology of the project. This chapter is divided into two main parts which are the design of software and the design of hardware. The discussion on the methodology software implementation and hardware assembly will be explained in detail.

Chapter Four covers on result and discussion. All the results obtained from the project through testing and calibration process are explained and analyzed. This part concern more on the problem occurred and solution to overcome the weaknesses.

Last part, chapter Five is the conclusion and recommendation. This chapter testifies the success of the project, limitation and the suggestion for the future development related to this work.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter brief in detail about the tools used and rough overview about this project. From this chapter, the features of the all the device and software include in this system are covered. There will be two parts; part 1 is about the background of this project, while part 2 is about previous study that related to the proposed topic.

2.2 BACKGROUND

2.2.1 COUNTER

A counter that can change its state in either direction, under control of an up–down selector input, is known as an up–down counter. The circuit can count numbers

in up and down modes depending upon the state of the selector. It can be used to count the number of persons entering a hall in the up mode at entrance gate. In the down mode, it can count the number of persons leaving the room by decrementing the count at exit gate. It can also be used at gates of parking areas and other public places. This circuit divided in three parts: sensor, microcontroller and counter display. The sensor would observe an interruption and provide an input to the controller which would run the counter in up/down mode depending upon the selector setting. Based on the distance sensor that will be used in this system, the distance is the main factor that will affect the output of the sensor. However, the output will be the type of analog and in this stage; an analog to digital programming converter will be needed to convert to the analog to digital output. In the range of 10 to 80 cm from the side of the door, sensor will sense the present of visitor, send signal to microcontroller and save the updated data. All the data will be displayed on 16 x 2 characters LCD display with yellow backlight through the controller.

Once the visitor enters the room, sensor will detect the present of people and counter will start to count up and vice versa. The counter will send signal to relay to turn on the lighting system as the counter start to detect one visitor and above while the relay will turn off only if the counter hit zero. For convenient, this counter can be reset by administrator and any error on the counter can be repair.

Figure 2.1 : Counter [14]

2.2.2 MICRCONTROLLER

A microcontroller is a highly integrated chip which performs controlling functions. A microcontroller, or embedded controller, is similar to a microprocessor as used in a personal computer. PIC microcontroller is a processor with built in memory and RAM and can be use to control the input and output of the project.

Microcontrollers are microprocessors integrated with peripherals on a single integrated circuit. The microcontroller is essentially a microprocessor adapted for control type applications. They are compact in size and yet retain the computational power of traditional microprocessors, allowing them to be used in a multitude of applications. The evolution of microprocessors into complex instruments and machines has led to sophisticated, fast real-time control capability. Microprocessors of 16 or 32 bit capability with associated interrupt handler chips, programmable timer chips, ROM and RAM chips, have been replaced in many control function instances by single chip I/O microcontrollers with all peripherals embedded on the same chip with the microcontroller.

Microcontrollers differ from microprocessors in many ways. Microcontrollers are independently programmable and can have a great deal of additional functionality combined on the same integrated circuit. A typical microprocessor can access from a megabyte to a gigabyte of memory, and is capable of processing 16, 32, or 64 bits of information or more with a single instruction.

In this project, microcontroller is preferred because of it flexibility rather than gate logic. If gate logic been use, this system is difficult to modified or improved. By using microcontroller, the coding can be varied and replaced if new improvement required.

Figure 2.2 : Microcontroller [15]

2.2.3 SK40C

SK40C is a start up kit for beginner to design and test a system. In this project, SK40C suitable to fulfil this project as the circuit compatible with various input and output. SK40C is another enhanced version of 40 pins PIC microcontroller start up kit. It is designed to offer an easy to start board for PIC MCU user. However, all interface and program should be developed by user. This board comes with basic element for user to begin project development [13].

For this project, this start-up kit is chosen because this is the most suitable circuit design that fit this project and yet, easy to understand.

These are some features of SK40C [10]:

1. ICSP connector for UIC00A - simple and fast method to load program.
2. Perfectly fit for 40 pins 16F and PIC18F PIC.
3. 2 programmable switch.
4. 2 LED indicators.
5. Exchangeable crystal where the frequency of crystal can be varied.
6. Existing pad for 16 x 2 characters LCD display.
7. UART connection to interface with other controller or even computer.

8. USB on board for certain PIC18F.
9. Users are able to utilize the function of PIC by directly plugging in the I/O components in whatever way that is convenient to user. Bootloader can still be applied in loading program.
10. Without PIC microcontroller to provide the freedom to choose PIC type.

The accessible of SK40C:

1. Components that needed connected onto the I/O port.

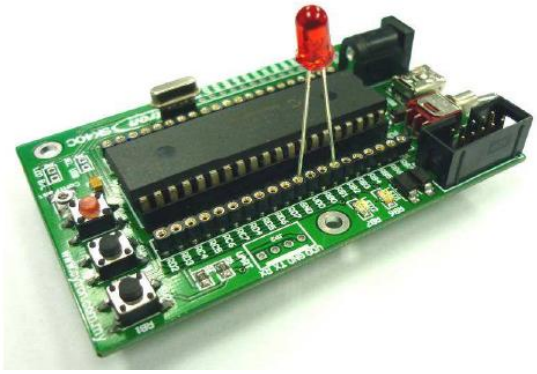


Figure 2.3 : Component connection to SK40C [16]

2. The I/O port can be extended to another board using jumper wire.

Figure 2.4 : Wire connection to SK40C [16]

3. I/O pins of the SK40C plugged onto a breadboard. Then, I/O pin can be access through the breadboard.

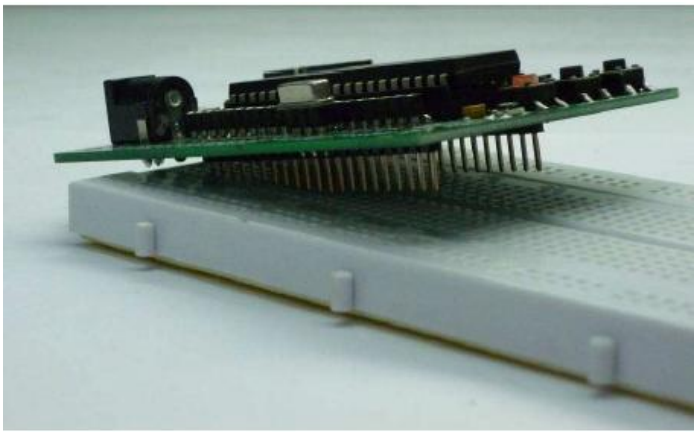
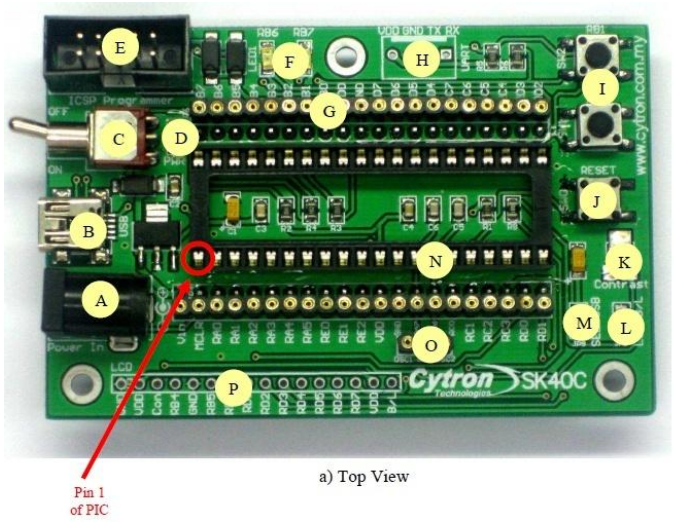


Figure 2.5 : SK40C connection to breadboard [16]

4. I/O pins of the Start-up Kit plugged onto a donut board. So user can solder the pins onto the board to access the connection of input and output.



a) Top View

Figure 2.6 : SK40 labelling [16]

Label	Function	Label	Function
A	DC power adaptor socket	I	Programmable Push Button
B	USB Connector	J	Reset button
C	Toggle Switch for power supply	K	LCD contrast
D	Power indicator LED	L	JP8 for LCD Backlight
E	Connector for UIC00A Programmer	M	JP9 for USB
F	LED Indicator	N	40 pin IC socket for PIC MCU
G	Header pin and turn pin	O	Turn pin for crystal
H	UART Connector	P	LCD Display

Table 1.1 : Lable of function

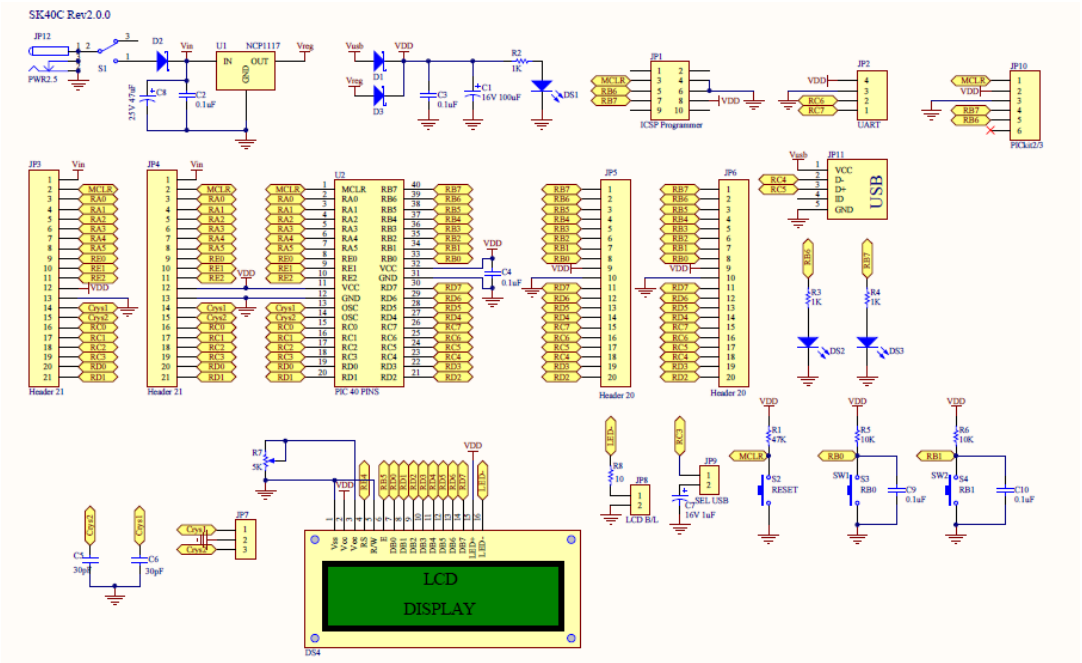


Figure 2.7 : Circuit diagram of SK40C [13]

2.2.4 PIC 18F452

This powerful 100 nanosecond instruction execution are easy-to-program with which have 77 single word instructions with CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC architecture into a 40-pin package. It is upwards compatible with the many PIC devices and thus providing a seamless migration path of software code to higher levels of hardware integration. The PIC18F452 features a 'C' compiler friendly development environment where high level language such as C++ programming can be used. It also comes with 256 bytes of EEPROM, Self-programming, an ICD, 2 capture/compare/PWM functions, 8 channels of 10-bit analog-to-digital (A/D) converter. The Analog-to Digital (A/D) converter is important as this project use IR proximity sensor (GP2YOA21YK). The output of the sensor is analog and PIC can read digital value only.

The synchronous serial port can be configured as either 3-wire Serial Peripheral Interface or the 2-wire Inter-Integrated Circuit bus and Addressable Universal Asynchronous Receiver Transmitter (AUSART). These features make it ideal for instrumentation and monitoring, data acquisition and power conditioning [25].

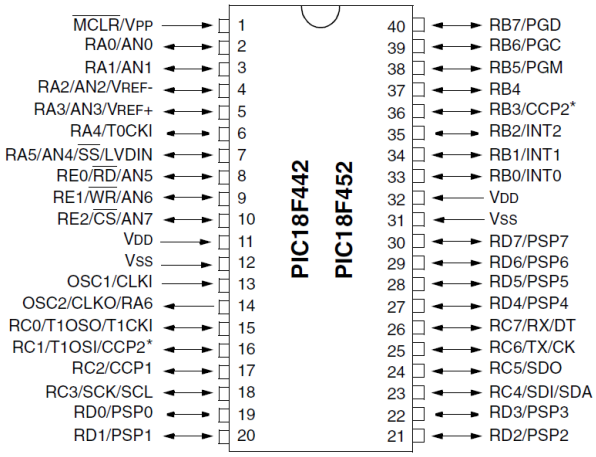


Figure 2.8 : PIC 18F452 pin diagram [18]

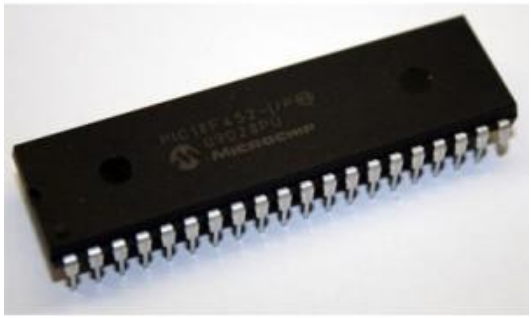


Figure 2.9 : PIC 18F452 [19]

The basic features of PIC 18F452 are:

1. Consist of 40-pin Programmed Dialogue with Interactive Programs (PDIP)
2. 32KB flash program memory
3. It can attain 40MHz max crystal speed:
4. The RAM Bytes is 1,536 and contain 256 EEPROM Bytes
5. PIC 18F452 provide timers which is 1 x 8 bit and 3 x 16-bit
6. Analog-to-digital converter (ADC) consist of 8channel and 10-bit
7. This PIC have 2 comparators

PIC divided into 3 types of memories:

i. Program Memory - A memory that contains the program after the program had been burned. As a reminder the program counter executes commands that stored in the program memory one after the other [24].

ii. Data Memory - This is RAM memory type. It contains a special registers such as SFR (Special Faction Register) and GPR (General Purpose Register). The variables that stored in the data memory during the program are deleted after we turn off the microcontroller [24].

These two memories have separated data buses, which makes the access to each one of them very easy.

iii. Data EEPROM (Electrically Erasable Programmable Read-Only Memory) - A memory that allows storing the variables as a result of burning the written program [24].

Each one of them has a different role. Program memory and data memory is the two memories that are needed to build a program while Data EEPROM is used to save data after the microcontroller is turn off.

2.2.5 PIC Programmer

The PIC Programmer is a tool use to load a program to the PIC 18F452. The PIC Programmer use USB to establish the connection between Laptop and microcontroller in order to import the hex file into the PIC. The program will execute when connected to computer and microcontroller turned on. PICkit 2 Readme UIC00B is designed to program PIC Microcontroller that includes most of the PIC

family including PIC 18F452. Besides 8bit,16bit and 32bit PIC MCU also can be programmed using this programmer. On board In Circuit Serial Programming (ICSP) connector offers flexible methods to load such this program. USB port is commonly available and widely used on Laptop and Desktop PC, thus they are very convenient to use UIC00B.Program most of the +3.3V or +5V PIC. It is compatible with PICkit2's UART Tool and Logic Tool and can program most of the current 8-bit, 16-bit, and 32-bit Flash PIC microcontroller.

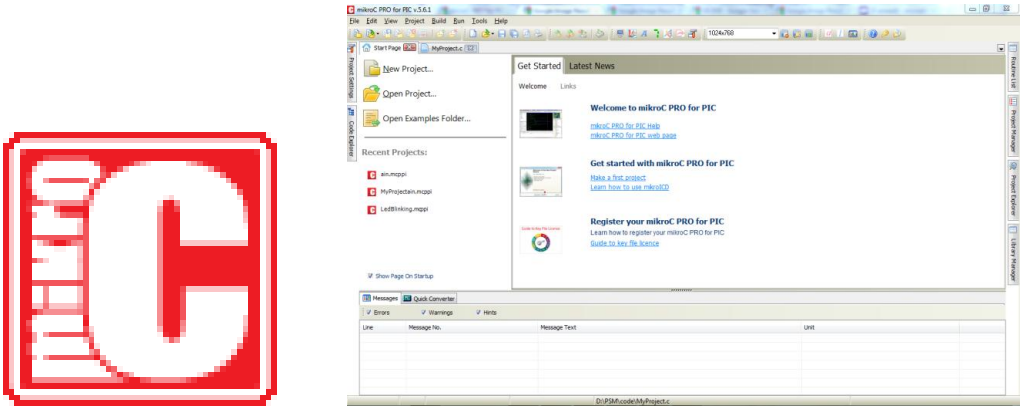
Moreover, it is flexible to use with Windows XP, Vista and 7 and also with Microchip's PICkit 2. This PIC Programmer can be powered directly from USB port and no external power required for UIC00B to function. This UIC00B supports on-board programming which eliminates the need of plug-in and plug-out of PIC MCU. This flexibility also allows user to modify the program without removing the PIC from the development board [15].

Figure 2.10 : UIC00B with USB and rainbow cable [20]

2.2.6 MicroC PRO

The mikroC PRO for PIC is a powerful, feature-rich development tool for PIC microcontrollers. It is designed to provide the programmer with the easiest possible solution to developing applications for embedded systems, without compromising performance or control. PIC and C fit together well where nowadays PIC is the most popular 8-bit chip in the world, used in a wide variety of applications, and C, prized for its efficiency is the natural choice for developing embedded systems. MikroC PRO for PIC provides a successful match featuring highly advanced IDE, ANSI compliant compiler, broad set of hardware libraries and comprehensive documentation. The mikroC PRO for PIC is a user-friendly and intuitive environment.

This software mikroC PRO for PIC allows quickly develop and deploy complex applications. The C source code can be writing using the built-in Code Editor (Code and Parameter Assistants, Code Folding, Syntax Highlighting, Auto Correct, Code Templates, and more.). It uses included mikroC PRO for PIC libraries to dramatically speed up the development such as data acquisition, memory, displays, conversions, communication and more. Besides, it monitors the program structure, variables, and functions in the Code Explorer. microC PRO also generate commented, human-readable assembly, and standard HEX compatible with all programmers. It use the integrated mikroICD (In-Circuit Debugger) Real-Time debugging tool to monitor program execution on the hardware level where it is convenient for beginner. Moreover, it able to inspect program flow and debug executable logic with the integrated Software Simulator and generate COFF(Common Object File Format) file for software and hardware debugging under Microchip's MPLAB software [26].



a) b)

Figure 2.11 : a) microC PRO icon b) microC PRO start page software

2.2.7 PICkit 2

The Microchip PICkit 2 device programmer and in-circuit debugger consists of software which runs on a PC and hardware. Programmer-only software comes with the PICkit 2. MPLAB includes both programming and in-circuit debugging software. With the PICkit 2, user can step through assembly source code on-screen while observing what the hardware is doing. User also can select registers to watch by their labels as they can step through the program. The breakpoint also can be set. So that, the program can be run at normal speed and exercise the hardware up to that breakpoint. Next, the user can observe at the contents of the registers of their choosing. The unit has a USB connector for serial communication with a host PC and a 6-pin female header for communication with a flash PIC microcontroller

The PICkit 2 can operate in two operating modes which is programmer mode and debugger mode. In the programmer mode, only the code is programmed into the device for standalone where PICkit 2 is not connected during the operation. In both the programmer and debugger operating modes, the user code is programmed into the PIC microcontroller. While in the debugger mode, the PIC debugger code used

by the PICkit 2 is also programmed into program memory locations reserved for the purpose.

The PICkit 2 can operate in two hardware configurations:

i. Device programmer for programming flash devices.
ii. Debugger/programmer for working with flash devices with in-circuit debugging capability.

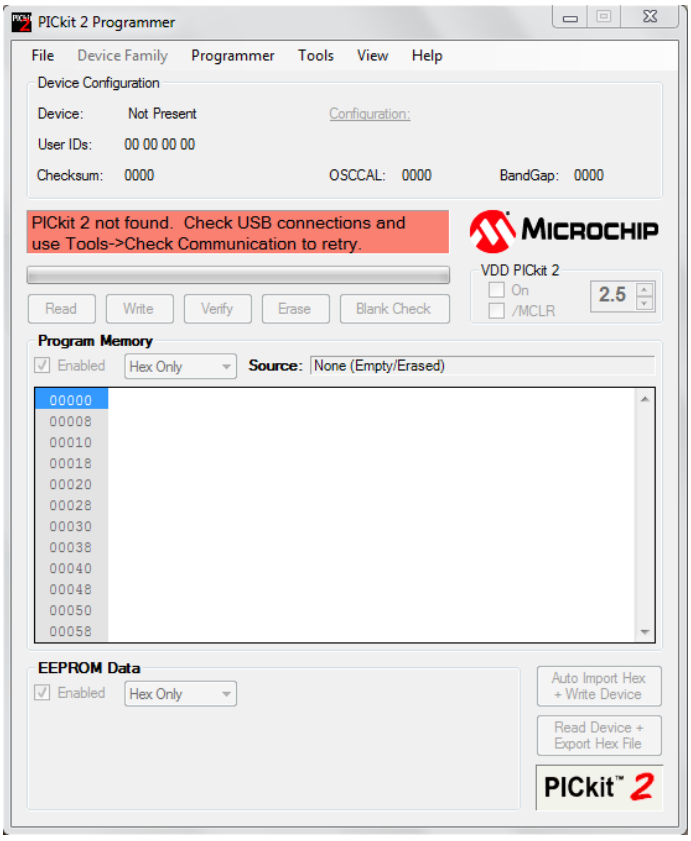


Figure 2.12 : PICkit 2 software

2.3 Related Work

i. Street Light

Switch the lights on and off automatically during night and day time respectively. This system used Light Dependent Resistor (LDR). The resistance changes according to the amount of light falling on it. The system is said to reduce energy consumption and CO2 emissions by up to 80 percent, plus it lowers maintenance costs and reduces light pollution [11].

ii. Motion Detector Lighting Control System

This system use motion detection to control lighting system. It consists of active or passive sensor. However, this system has delay and depends on motion to function. The weakness is if occupant is sleeping and static, the lighting system is turn off.

iii. Bidirectional Visitor Counter

Two IR transmitter-receiver pairs are used at the passage. Microcontroller controls counting and displays the number of persons present inside the hall. This counter can change its state in either direction, under control of an up–down selector input known as an up-down counter. It can count numbers from 0 to 9999 in up and down modes depending upon the state of the selector. It also can be used to count the number of persons entering a hall in the up mode at entrance gate. While in the down mode, it can count the number of persons leaving the hall by decrementing the count at exit gate [8].

iv. Occupancy Detection

Count the number of people that enter and exit each room (counter). If the counter is more than zero, light will turn on. On the other hand, if the counter is equal to zero, light turn off.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The software implementation and hardware implementation are explained in detail through this chapter. Software implementation discussed on the designing the program by flowchart, writing and testing the program. The hardware methodology is divided into two parts. First part discussed the method by using the microcontroller independently. The second part is the implementation by combined sensor and relay simultaneously. Basic knowledge on the design and high level language is acquired.

3.2 SOFTWARE IMPLEMENTATION

This project involves several steps:

1. Define the task
2. Designing the system
3. Writing the control program
4. Test and debug

3.2.1 Defining the task and problem

Figure 3.1 : Block diagram of overall system

The user accesses the abilities of the microcontroller by writing a program that performs the desired functions. The main function of this project is to count visitor but there are other aspect that must be consider. This system must differentiate when a visitor enter or leave the room. Sensor only sense the present of a person but it is microcontroller task to define either a person is enter or leaving the laboratory. Besides that, a LCD display will be provide in this system to display the total visitor exist in the room. Each time visitor come in and out, it can be monitor through this LCD display and provide information about the present data.

3.2.2 Designing the system

Firstly, MicroC PRO and PICkit 2 v2.61 is a software need to be installed in personal computer to ease the process of testing and improve the programming in the next stage. This software is needed to design the programming and load the program to the microcontroller. In this project, we must able to burn the program into PIC using PIC programmer.

The first step in designing is choosing a suitable chip for this project. All microcontrollers contain a CPU, and chances are that we can use any of several

devices for a specific project. Within each device family, we usually find a selection of family members, each with different combinations of options. In this project, a IC PIC 18F452A chosen because it is suitable for multitasking programs and serial communication [1].

As a starting, SK40C is a start-up kit used to test this project with variable input and output. In this system, the input will come from the sensor that detect visitor while the output is a LCD display and connected to a relay which interface with the lighting system.

After considering all the possibilities and analyze the data, the flowchart of the program is needed to understand and summarize the idea of this system. This flowchart will be used to write the control program. Flowchart below shows the flow on how generally microcontroller works and how it counting visitor using a specific idea.

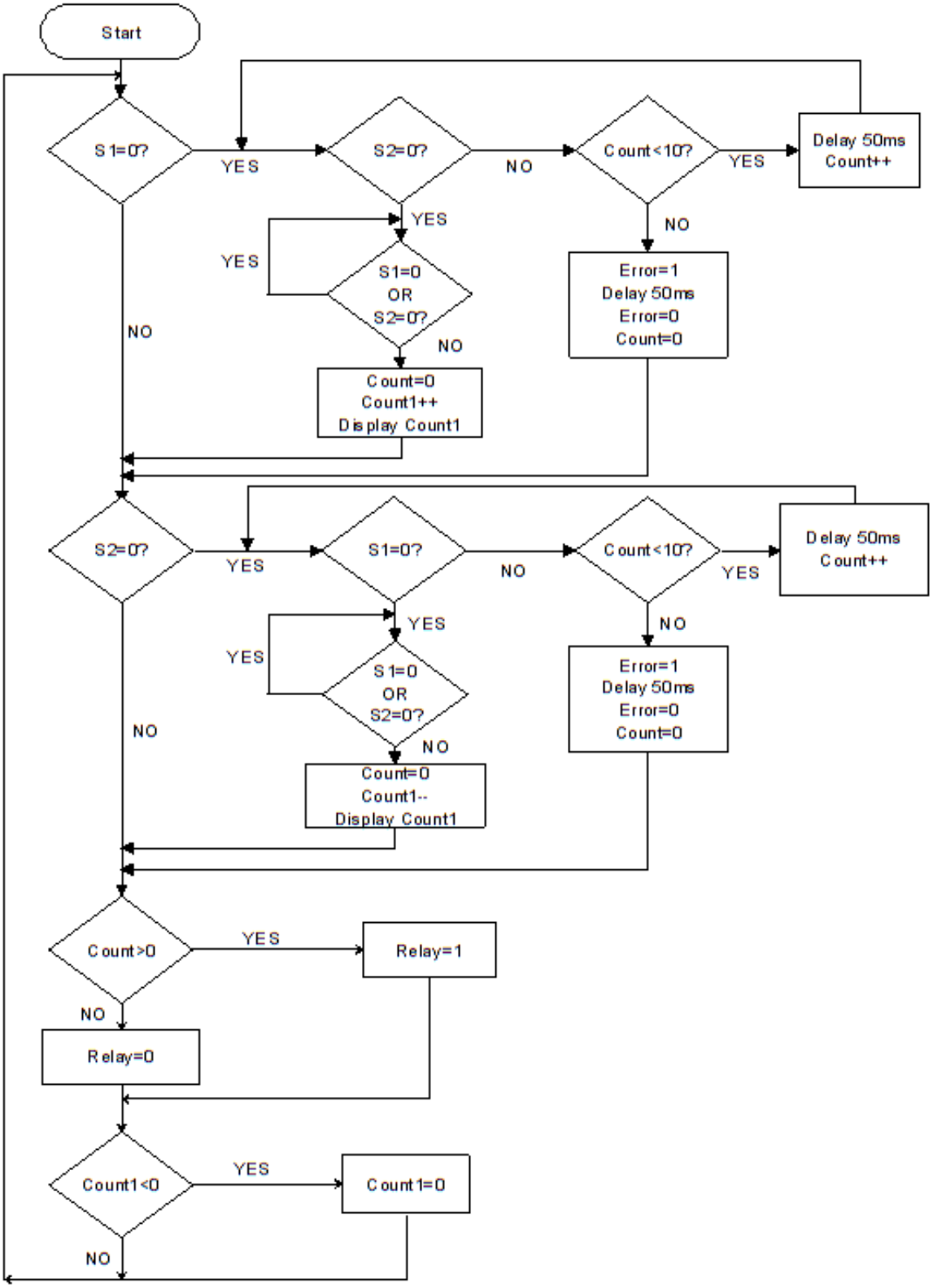


Figure 3.2 : Overall flowchart design

First of all, sensor 1 will detect any presence of object. If there are object detected, the microcontroller will proceed to detect sensor 2, and in 0.5 second range, there are object detected, the counter will counting up and relay will turned on. This counting is represent a visitor is entering the laboratory. Henceforth, it is similar for visitor that leaving the room. If sensor 2 detect the object first and a sensor 1 trace 0.5 second after sensor 1, the counter will counting down indicates a visitor is leaving the laboratory. As there are nobody left inside the room, which counter will hit zero, microcontroller will send data to control relay and turn off the lighting in the room.

There also an additional function inside microcontroller to calculate the height of the visitor that is entering and leaving the laboratory. It involve sensor 3 at the top of the door to calculate the difference between the door and the detected object that will equal to the height of the person.

3.2.3 Writing the control program

A programming language will be use depends on things such as desired execution speed, program length and convenience. For this project, the most suitable language is C++ language. The main advantages of C++ language are that there is not much vocabulary to learn, and that the programmer can arrange the program very fast. The high language C++ is very easy to learn and still a practical compact language. It comprises a good semantic. The syntax of C is also clear [27]. This language is a systems language suitable for low-level programming especially for student. Finally, C language is easy to understand, has facilities for structured programming and allows lexical variable scope and recursion, while a static type system prevents many unintended operations [7].

The system model designed is the key element used in this study. Without proper design and correct model, this study will not be successful. For this stage, a necessary tool is needed to be used as a medium for carrying out the simulation. After the control program is done without any error, hardware implementation is proceeding.

There are several parts in programming which is:

i. Programming using C language

For the embedded system in microcontroller, C language will be used to write the instruction to the microcontroller. C language is suitable to program the microcontroller because it is easy to organize and offers platform independently. Besides, by using microC PRO, C language is highly recommended.

ii. Programming with microC PRO

MicroC PRO is easy and convenient to be used. Only with a few step, a project can be designed. First, new project created to build a new program.

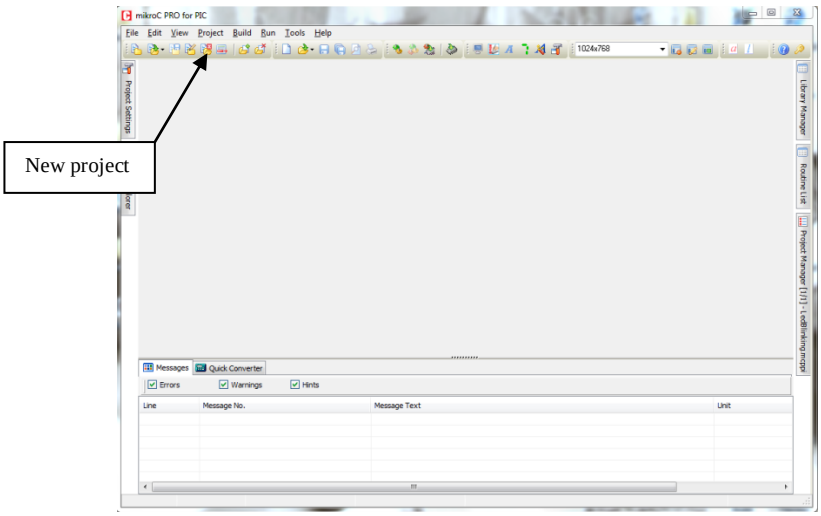


Figure 3.3 : MicroC PRO start page

Click ‘Next’ to skip the introduction.

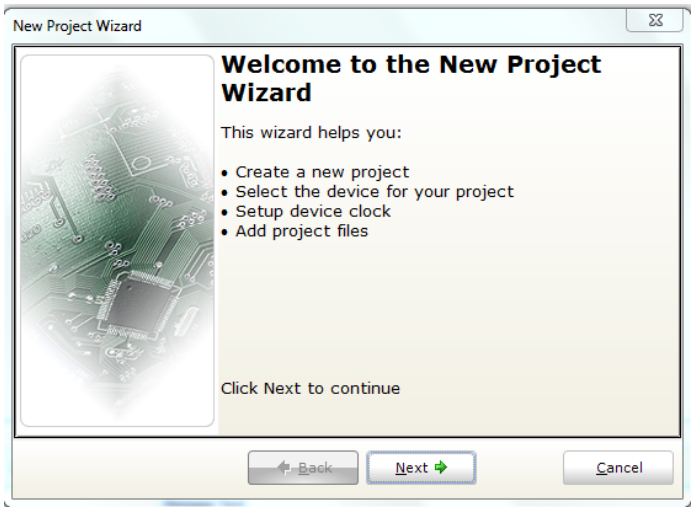


Figure 3.4 : First page to create new project

For the first step, choose device name. In this project, PIC 18F452 choose as mentioned before.

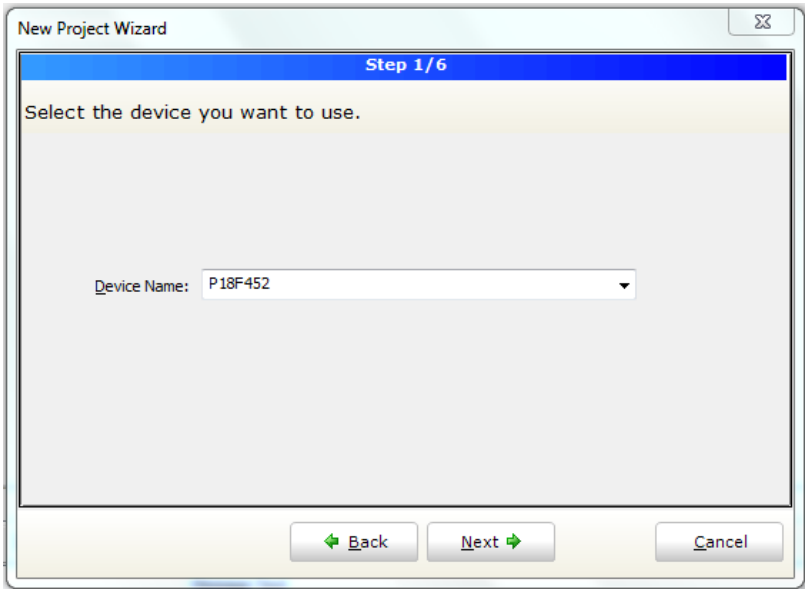


Figure 3.5 : Selecting the device

Next, clock of the device must be setup. For counter system, the suitable device clock is 20 MHz.

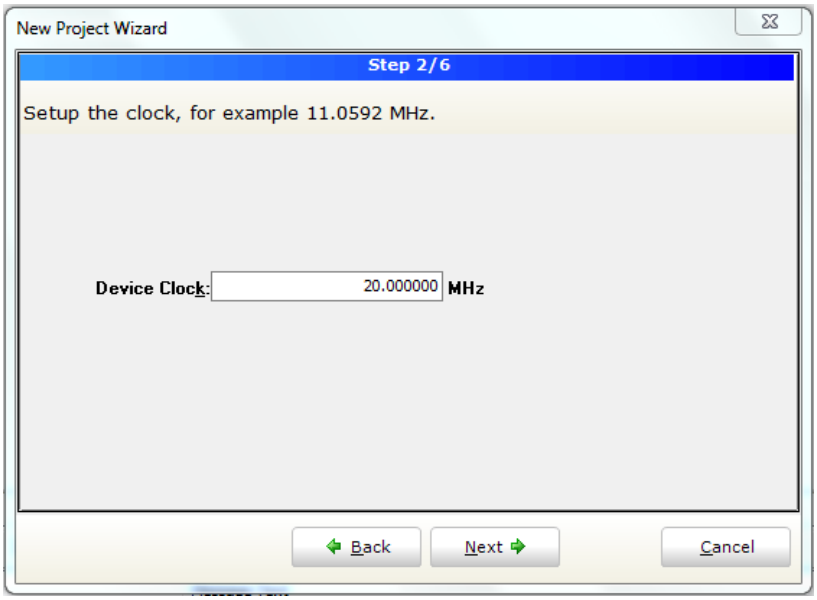


Figure 3.6 : Choose suitable device clock

Then, select the path to save the project that had been created. So, next time if the projects need to be open, this folder will show the counter program.

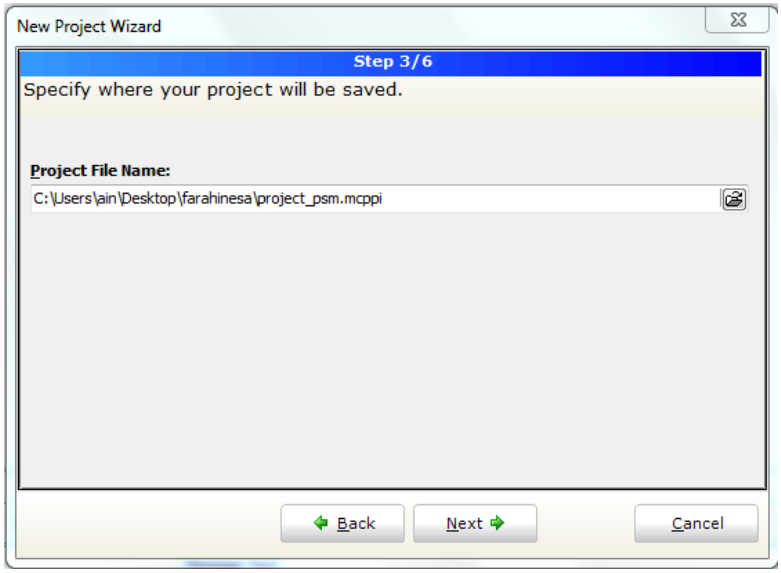


Figure 3.7 : Select the path to save project

Click next to proceed until step 5/6 and lastly click finish for the last step.

At this moment, the programming can be design and then build the program to check the error. A Program with no error will be executed in hex file.

iii. Programming with PICkit 2

In the previous section, a hex file is created and it is ready to be loaded into the microcontroller. The procedures to load the hex file into the microcontroller are given in this section.

SK40C is a PIC microcontroller start up kit developed by CYCTRON. It consists of boot loader capabilities and this can ease the process of loading program into microcontroller.

After connecting the PIC programmer and the microcontroller, the PICkit 2 programmer is launched in PC.

By using PICkit 2, the programming will be loaded to the microcontroller. By clicking on the “auto import hex + write device”, select the project that had been saved and the program should be imported to the microcontroller automatically.

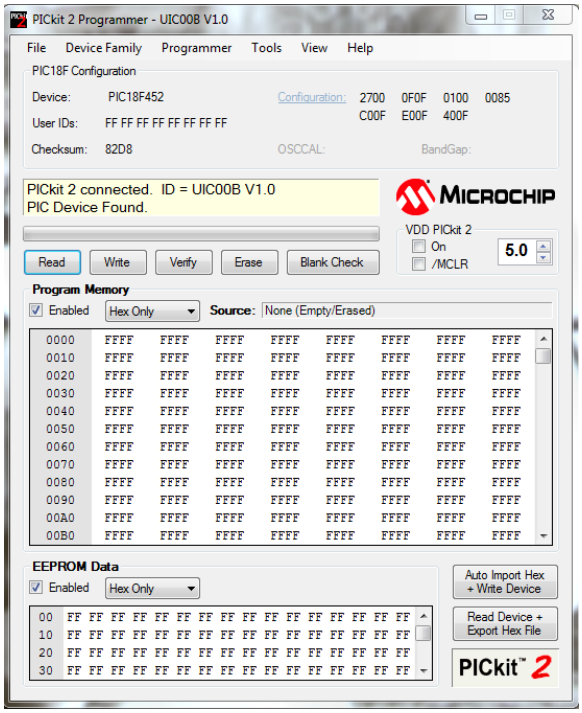


Figure 3.8 : PICkit 2 programmer detect PIC 18F452 device

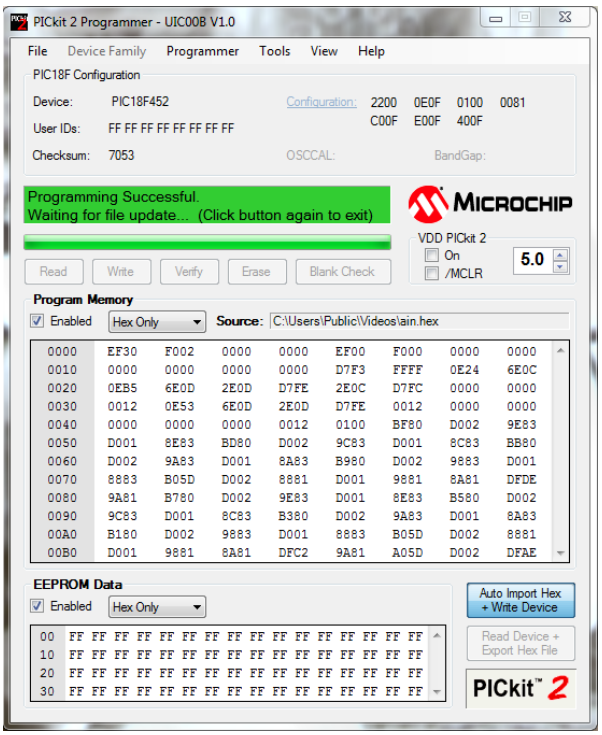


Figure 3.9 : The hex file is successfully imported to PIC

3.2.3 Testing and debugging

This is the most important part. After a program is written, or a section of one, it needs to be tested and as necessary and any mistakes found need to be correct to get it working properly. As the control program is done, the next phase, the project is proceed to the next. The process of ferreting out and correcting mistakes is called debugging. Easy debugging and troubleshooting can make a big difference in how long it takes to get a system up and running [1]. In this project, this phase is the hardest part where there are many error and obstacles faced towards the successful designed system.

After the PIC 18F452 had been programmed, it placed to the SK40C and connected to input and output to run the system. This chip had been programmed several times before desired output is obtained. By using microcontroller, the program can be easily change for convenience or depend on requirement of the project. The input and output must be taken into consideration with a suitable range of current to avoid damage on PIC 18F452. The complete coding can be referring to Appendix B.

3.3 HARDWARE IMPLEMENTATION

Hardware implementation can be divided into two parts. The first part consist SK40C and microcontroller only using the successful debug program. The other part is the complete system including the IR proximity sensor and relay interfacing with the lighting system.

3.3.1 Part I (Using SK40C)

The first part of this project involve SK40C and PIC 18F452 only. Once the programming had been done, the program tested on SK40C board and the output observed. In this stage, the push button pin is referred as the sensor. RB0 and RB1 indicate sensor 1 and sensor 2 respectively. RB6 and RB7 denote the output of the microcontroller. During the testing, RB6 is the input of the relay that is connected to the lighting system while RB7 is the connection to buzzer that will sound on if error occurs. Both of this connection can be observed through RB6 and RB7 LED. As the push button pin, RB1 and RB2 pressed according to the program, RB6 LED will turn on. RB7 LED will turn on only if error had been detected. For instance, both push

buttons is pressed for a long period (more than 0.5 second), so it means the buzzer will sound on and at the same time RB7 LED will remain lit.

For the first demo, the program is limit to 5 persons as maximum. When the counter hit 5, the LCD will display “FULL COUNT” and the program will not count if the number exceeds 5. This program is design for testing purpose and to observe the reliability of the microcontroller. The full coding for this part can be referred to Appendix A.

3.3.2 Part II (Complete Project)

In this part, sensor and relay is included during testing. Therefore, the C++ programming is altered a little bit so that it compatible to use with sensor and relay. During this period, there are so many problem occurred and this will be discussed in discussion part. One of them is when the sensor is not reliable and failed to obtain the desired output compared to part I implementation. IR Proximity sensor had been choosing for this system as the input while relay is function as the output of the microcontroller. This part still used SK40C as the main board to test the program. So, no additional circuit board is needed except for the relay and sensor connection. In this case, a few addition on programming solved this problem which is analog-to-digital converter programming is required. The complete programming can be referred to Appendix B.

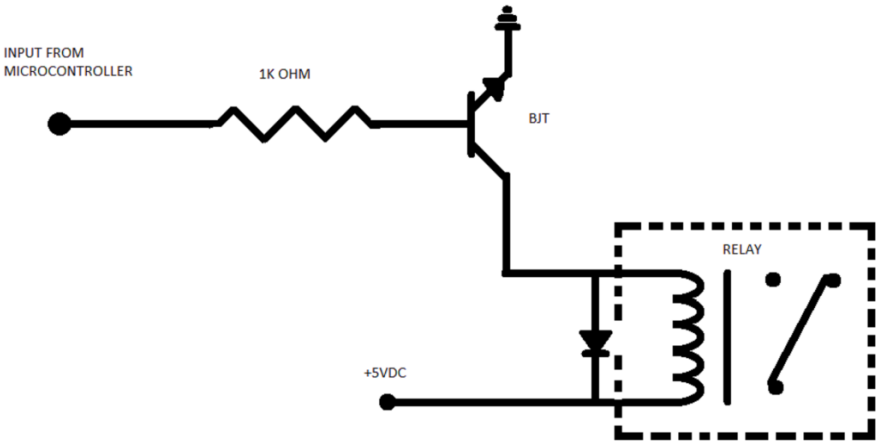


Figure 3.10 : Relay circuit diagram

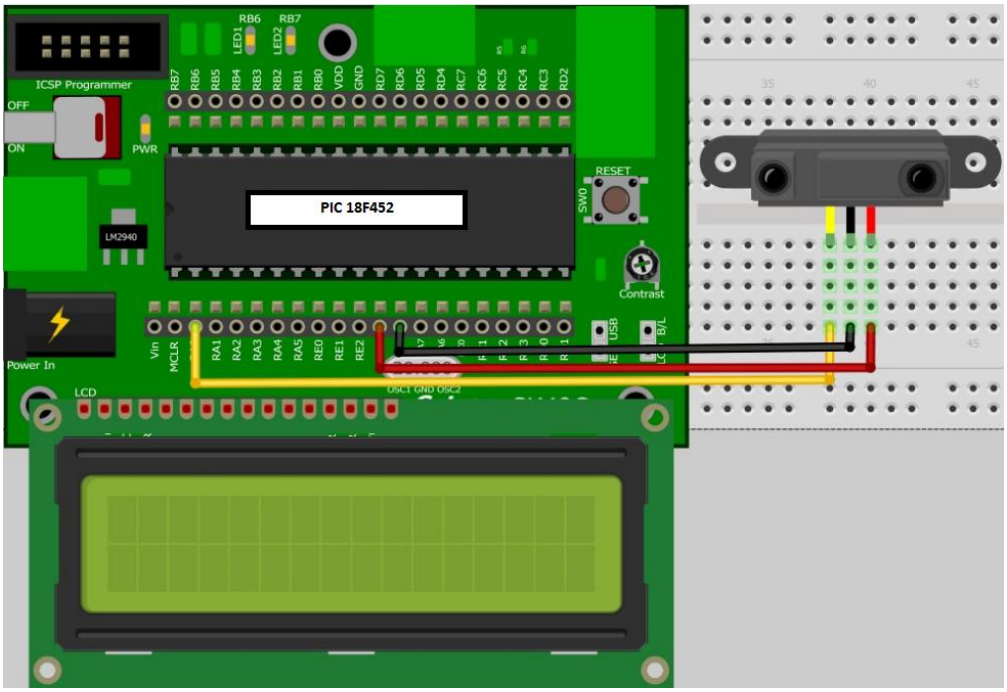


Figure 3.11 : Sensor connection to SK40C [10]

3.3.3 Type of Call Function

Function of analog-to-digital converter to detect presence of object:

```
void readSensor(void)
 {
      int j;
      for(j = 0 ; j < 10 ; j++)        // take analog result for 10 times
      {
         s1_value = s1_value + ADC_Read(1);
         s2_value = s2_value + ADC_Read(2);
      }
      s1_value = s1_value/10;       //get average
      s2_value = s2_value/10;

      if (s1_value>95)
        sensor1=0;   //detect object
      else
         sensor1=1;  //no object

     if (s2_value>95)
        sensor2=0;    //detect object
      else
        sensor2=1;    //no object
 }
```

Figure 3.12 : Analog-to-digital call function

Function of analog-to-digital converter to calculate height:

```
void readSensor3(void)
 {
      int j;
      for(j = 0 ; j < 10 ; j++)        // take analog result for 10 times
      {
         s3_value = s3_value + ADC_Read(3);
      }
      s3_value = s3_value/10;       //get average
 }
```

Figure 3.13 : Analog-to-digital call function for sensor 3

The coding above shows that ADC for the sensor that needed to make sure the output of sensor converted to digital before microprocessor can understand the data. This call function used for sensor 1 and sensor 2.

Function to calculate height of visitor:

```
void calculateHight(void)
 {
      Vout=(s3_value*500000)/1024;

      if ((Vout > 43945)&&(Vout < 279785))     // read only from 0.4V = 80cm
to 2.8V = 8cm
      {
          Range_an=(Vout-19000)/2099;
          Range=1000/Range_an;
          Hight=210-Range;
      }
 }
```

Figure 3.14 : Call function to calculate height of visitor

Function to display the updated total visitor inside laboratory:

```
void displayLCD(int y)
{
    char txt[7];
    IntToStr(y,txt);
    Lcd_Cmd(_LCD_CLEAR);
    Lcd_Out(1,7,txt);
    Lcd_Out(1,1,"Occupant: ");
 }
```

Figure 3.15 : Call function to display total visitor

Function to display the introduction for the beginning of the system:

```
void introduction(void)
{
    unsigned char i;
    Lcd_Cmd(_LCD_CLEAR);
    Lcd_Out(1,1,"    WELCOME     ");
    Lcd_Out(2,1," SELAMAT DATANG ");
    delay_ms(2000);
    // Move text to the left 16 times
    for(i=0; i<16; i++)
    {
      Lcd_Cmd(_LCD_SHIFT_LEFT);
      delay_ms(250);
    }
    Lcd_Cmd(_LCD_CLEAR);
    Lcd_cmd(_LCD_CURSOR_OFF);
}
```

Figure 3.16 : Call function to display the welcome and greeting

Connection between the sensor and microcontroller is referring to the base of microcontroller that is defining on the programming. RA1 and RA2 is the base that receives data from sensor 1 and sensor 2 respectively. Same goes to relay connection that is done for part I which connected through RB7. The ground base of IR proximity sensor and relay must be grounded in order to function.

3.3.4 Hardware Component And Design

i. PIC 18F452

PIC 18F452 is used as processor in this project because of it flexibility and advantages. This 40-pin PIC is put inside the SK40C and testing will be done using SK40C itself. So, it is not necessary to take out the PIC every time the program loaded to the microcontroller.

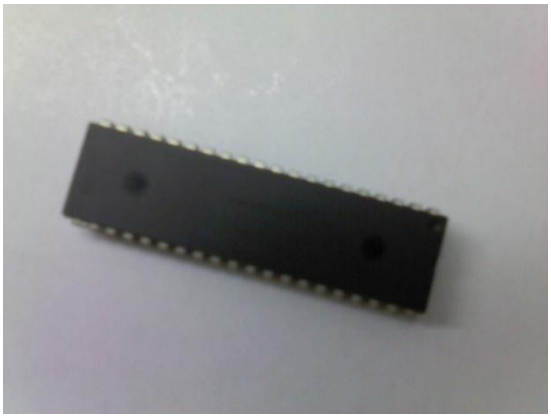


Figure 3.17 : PIC 18F452 type

ii. SK40C

It is easy to use this hardware where the input and output can be any device. No circuit designation required by using SK40C. Thus, this can ease the project flow and reduce the error caused by failure during circuit designation.

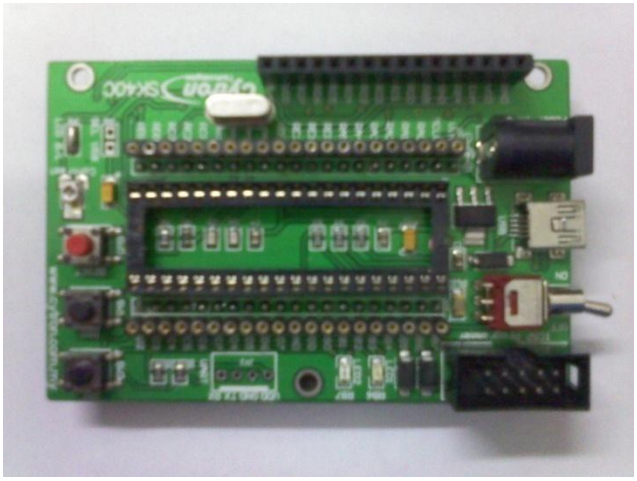


Figure 3.18 : SK40C board

iii. Sharp GP2YOA21

This type of sensor is widely used; popular choice for application and development that require accurate distance measurements and inexpensive proximity sensor. Connect +5v to power and ground and the output signal is an analog voltage that varies from +3.5v to 0v, which is a proportional to the distance between the sensor and the object. This IR proximity sensor is more economical than sonar range finders. It provides much better performance than other IR sensor alternatives. Interfacing to most microcontrollers is straightforward which the single analog output can be connected to an analog-to-digital (ADC) converter for reading distance measurements. The output can also be connected to a comparator for threshold detection.

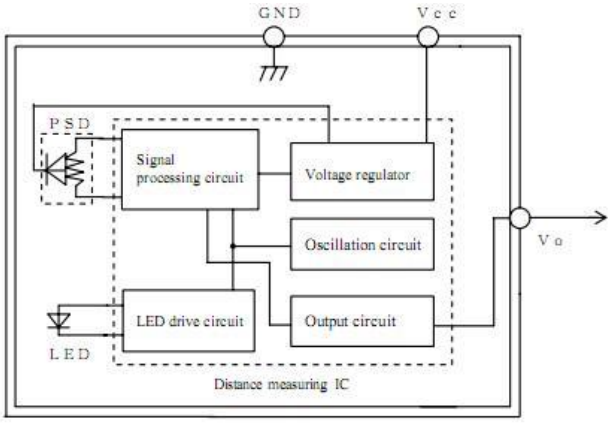
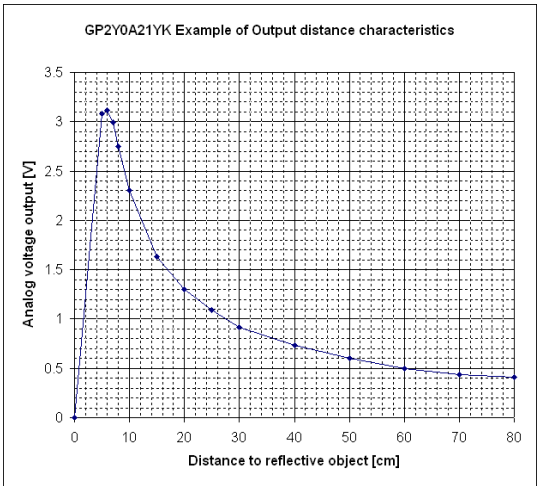


Figure 3.19 : Distance sensor block diagram [21]

An IR proximity sensor works by applying a voltage to a pair of IR light emitting diodes (LED's) which in turn, emit infrared light. This light propagates through the air and once it hits an object it is reflected back towards the sensor. If the object is close, the reflected light will be stronger than if the object is further away. The sensing unit is in the form of an integrated circuit (IC), it detects the reflected infrared light, and if its intensity is strong enough, the circuit becomes active. When the sensing unit becomes active, it sends a corresponding signal to the

output terminal which can then be used to activate any number of devices. For the purpose of this exercise, a small green LED will turn on when the sensor becomes active [9].



a) b)

Figure 3.20 : a) Output distance sensor characteristic [10] b) Distance sensor (IR proximity sensor) [22]

iv. Relay

A relay is an electrically operated switch, simplest, easiest and useful device. Most of relays use an electromagnet to operate a switching mechanism mechanically. It contains electromagnet (coil), switch and spring. In this project, it is necessary to control a circuit by a low-power signal that needs electrical isolation between control and controlled circuits. Relay is a medium between the microcontroller circuit and power lighting circuit. It also used when several circuits must be controlled by one signal. Contactor is another type of relay that can handle the high power required to directly control an electric motor. There are much type of relay which is protection relay, solid state relay, reed relay, contactor relay, latching relay, automotive relay

and much more in the market. All these relay have same function but different in specification [6].

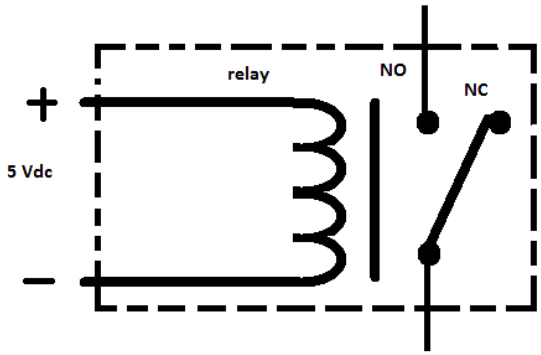


Figure 3.21 : Relay schematic diagram

As known, relay consists of two separate and completely independent circuits. One is at the bottom and drives the electromagnet. A switch is controlling power to the electromagnet in this circuit. When the switch is turn on, the electromagnet will produce flux, and it attracts the armature while armature is acting as a switch in the second circuit. When the electromagnet is energized, the armature completes the second circuit and the light will turn on. On the other hand, the spring pulls the armature away when the electromagnet is not energized and the circuit is opened. In that case, the lighting system will be in off mode [12].

A relay must be considered through several variables:

1. To activate the armature, user need to determined the voltage and current
2. Maximum voltage and current that can flow through armature and armature contacts
3. The number of armatures
4. The number of contacts for the armature
5. Whether the contact is normally open (NO) or normally closed (NC)

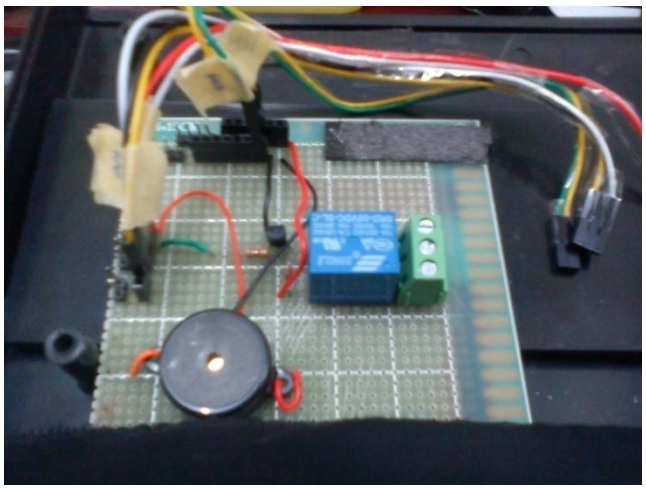
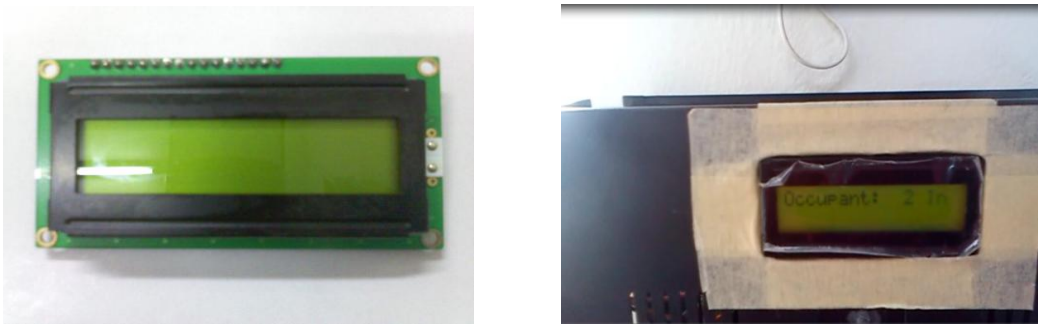


Figure 3.22 : Relay Circuit used in Project

v. Liquid Crystal Display (LCD)

A 16x2 liquid crystal display is used to display the total occupant inside the laboratory. This LCD also display either a visitor is enter or exit the room. It can be observed when occupant is entering; an output shows “In” and along with the increment of counter. Same goes if when occupant is leaving, LCD will display “Out” in a line with the decrement of the counter. Height of occupant detect by sensor 3 also displayed as output. The first line of LCD displays the total occupant inside the laboratory while the second line displays the height of occupant as they pass through the entrance.



a) b)

Figure 3.23 : a) LCD 16x2 b) LCD shows Occupant In

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

There are two parts discussed in this chapter which is divided to microcontroller independently and completed circuit. The performance and the ability of this project to function are mentioned on result. The microcontroller functionality is explained and complete result after the whole circuit is combined is observed. The system works as proposed and the desired output is obtained after a few re-tested and re-calibrated is done. The level of achievement and the successful in achieving the project objective as mentioned in the first chapter is determined.

4.2 RESULT

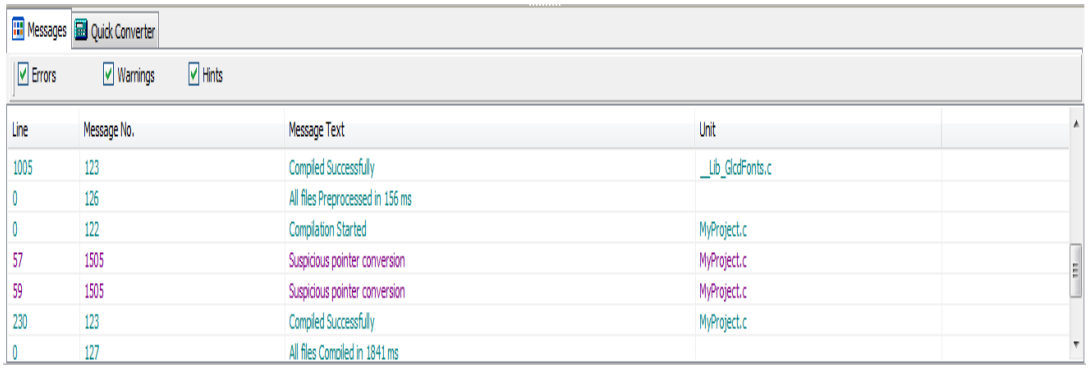


Figure 4.1 : Programming successfully compiled

The C++ programming is compiled successfully with no error. The full coding can be referring to Appendix.

i. Part I

For microcontroller part, the programming was tested using the SK40C hardware before the project is combined together.

RB0 button define sensor 1 while RB1 indicate sensor 2. Imagine a person pass through sensor 1 and 0.5 second after that, he should be pass through sensor 2, RB1 must be pressed 0.5 second after RB0 to represent the actual system. For the demo purpose, the programming is set to limit the counting up to five only. When the counter count up to five, it will shows the counter reach “Full Count” and the counter cannot count further.

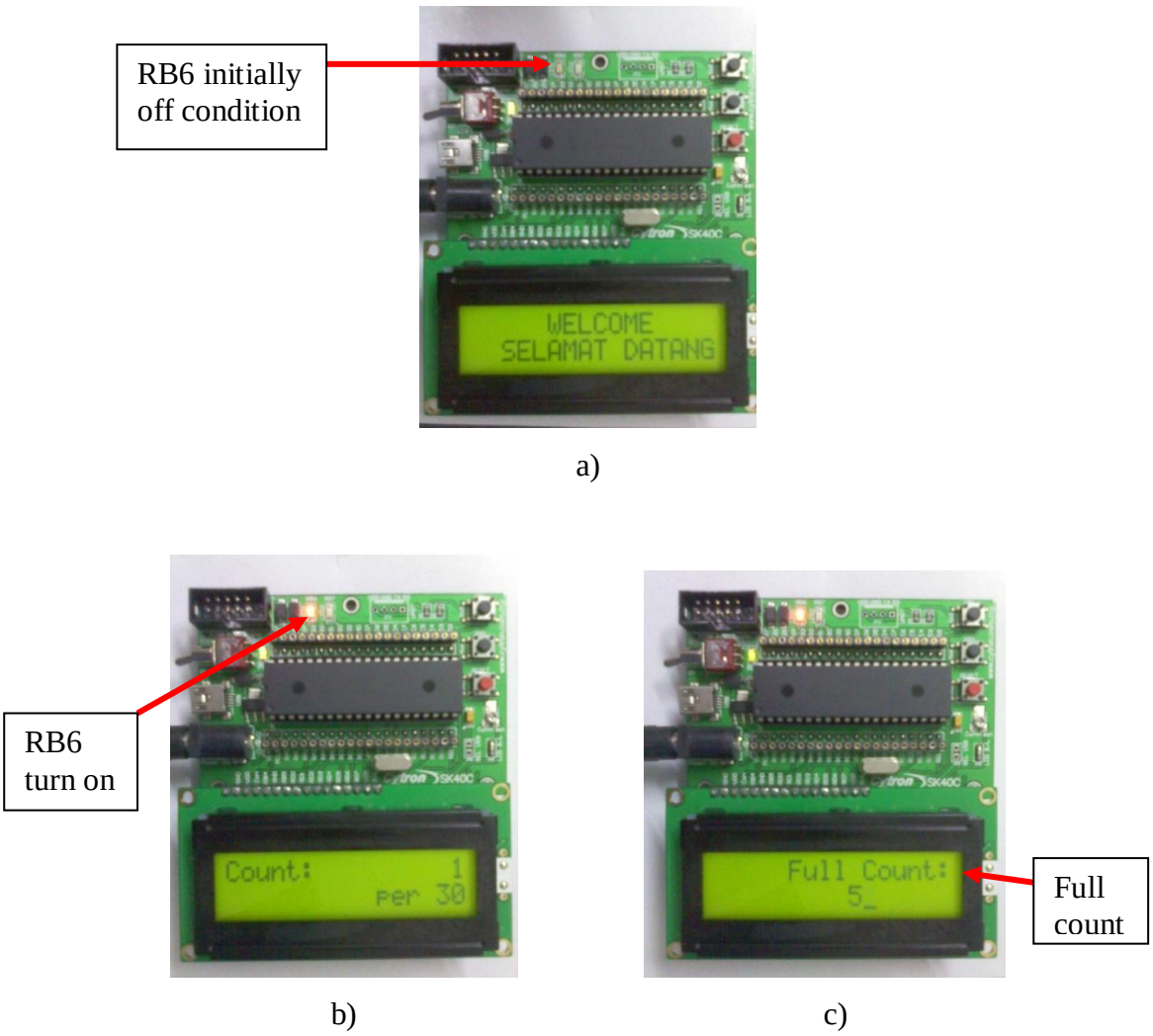
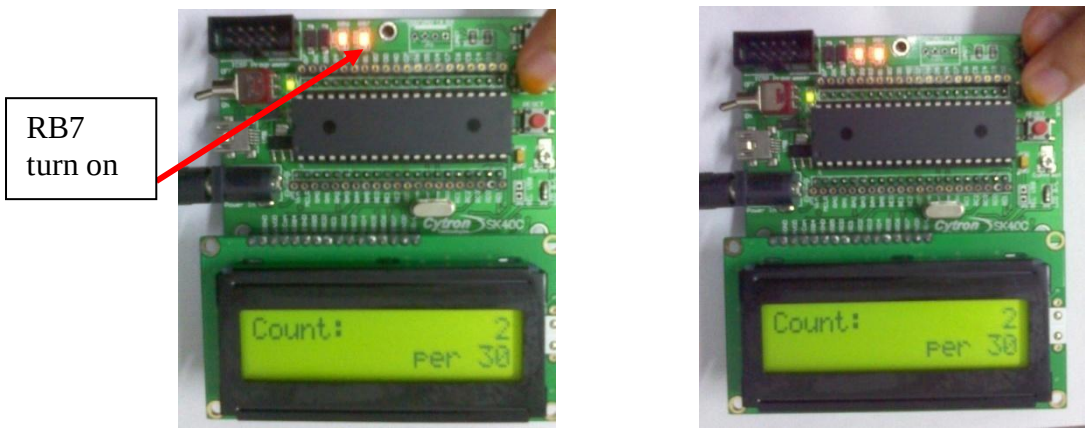


Figure 4.2 : a) System in off condition b) RB6 LED turn on when count greater than 0 c) LCD display “Full Count” for count equal to five

RB6 LED indicates the relay that is connected to lighting system. Relay is on if RB6 LED is turned on. RB7 LED indicates error. LED wills on if error occur. RB0 and RB1 define sensor 1 and sensor 2 respectively.

There is another situation where error occurs. Only sensor 1 either sensor 2 detect a presence of object, RB7 LED will turned on show that an error occurred. Similar if both sensors detect an object and the object did not move on after 0.5 second, error also will occur.



a) b)

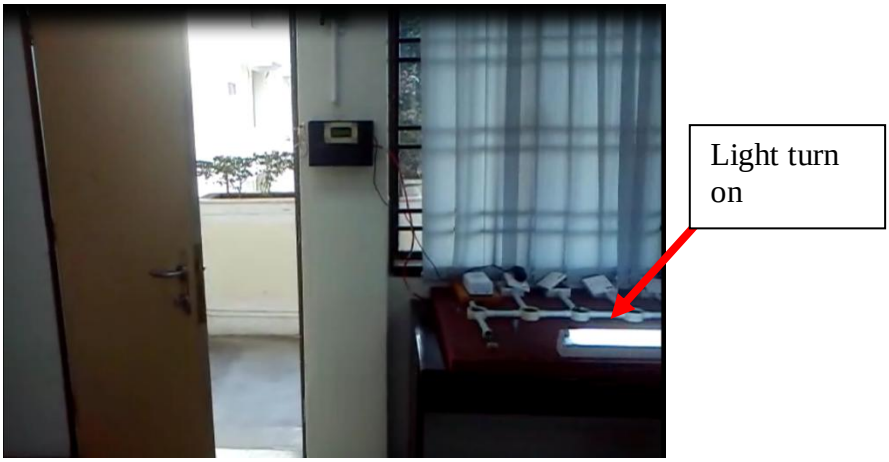
Figure 4.3 : a) RB7 LED turn on shows error when RB1 pressed more than 0.5 second b) RB7 LED turn on shows error when RB0 and RB1 pressed more than 0.5 second

If the counter count to zero, RB6 is turn off.

Figure 4.4 : RB6 turn off when counter equal zero

ii. Part II

This is the result when the completed circuit is implemented on the laboratory door. The first test when an occupant is entering, the counter counts up. The total occupant is one and fluorescent lamp is turn on. The system also calculates the height of the occupant as they enter or leave the laboratory.



a)

b)

Figure 4.5 : a) Fluorescent lamp turn on b) Total occupant is greater than zero

When the last occupant inside the laboratory is leaving, which means there is nobody inside the laboratory, counter count to zero and fluorescent lamp is turn off.

a)

b)

Figure 4.6 : a) Fluorescent lamp turn off b) Total occupant equal zero

4.2 DISCUSSION

4.2.1 Possibilities that need to be considered

During this project, there are many possibilities need to be considered. There are a few conditions that take to consideration:

1. Someone swings their arms as they walk in.

   Since the sensors are mounted at the around 140cm above the floor, it eliminates most of the problems that would occur from this. In order to prevent the counter from detect another object with similar shaped and their torso as another, the both beams have to be broken for a minimum amount of time or the count will be cancelled. The thickness of the average torso from the side is guaranteed that both beams will be broken for this minimum amount of time given if a visitor walks at a normal pace. The minimum time needed for both sensors to be covered is 0.5 second. This configurable via network commands is saved in the PIC 18F452 flash memory.

2. Someone enters the doorway and stands there.

   In this stage, counter will count it as error. Either sensor 1 or sensor 2 or both of them detects an object for more than 0.5 second, error will occur. This condition considered for a person that is stand close to either one of the sensor or both of them and they not moving. A buzzer will beep as along the error is detected.

3. If someone walks in right behind the other person.

   Unless both of the occupants are literally holding on to each other with no space between them torsos, the beams will be restored as soon as the first person passes. Before the next person can walk in order to prevent baggy clothing from setting off the sensor, a very small time threshold must be met for both beams to be clear. A microcontroller takes a few second to run the program before it executes to the next stage.

4. When two person walking side-by-side.

   This is a minor problem as the laboratory door is around 3ft wide. There is no way a visitor will hardly enter such small area by walking side by side. One should be in first while the other has to wait because with a limited size of the door, they need to pass one by one.

5. Someone waves their hand over the sensor to run up the count.

   They have to do it slow enough for both beams to be broken for the minimum amount of time specified according to the programming. This could happen so in this problem, occupant must be discipline enough not to do so.

6. Setting of the buzzer.

   A buzzer had been setup to discipline the person who enters the laboratory. For this simple counter, the programming is design with a few assumptions. When a person stand at the door and either sensor 1 or sensor 2 detect the presence, the buzzer will beep. Same goes if a person stand there and both sensor detect a presence, the buzzer will sound.

7. Function of reset button.

   A reset button on SK40C can be reset only if the system is unreliable. There are a few possibilities such as the counter did not detect a person when they go in but when they went out, there are one person left inside the room, so the counter will be negative count. This is where reset button used to reset the total data of occupant.

Distance sensor had been used in this project. Based on this sensor, analog to digital must be used to convert the output from sensor to digital as the input for PIC. And this ADC programming had been embedded to the PIC in the coding part. Furthermore, this project had been improved with a few function which the sensor will detect the height of the person pass through the entrance. This calculation of height is made to suit the height of the door in the laboratory at FKE. As the distance sensor had been use, the maximum expediency of the sensor give some benefit through this counter.

4.2.2 Problem of the overall system

However, there are a few problems due to the programming that reduce the flexibility of this system. Some of the time that the sensor is unreliable due to some error, the microcontroller failed to read the output from sensor and consequences to this counter will ignore the counting. Therefore, occupant entering the laboratory will not equal to the occupant that leaves the room.

It will lead to error such that, the counter will be negative value or the counter will never decrease to zero. Counter will be negative due to failure of detecting an occupant entering the door. In this case, lighting is turned off even there is an occupant left inside the laboratory. While the other side, counter will never decrease to zero once the system failed to detect a visitor that leaving the room. Therefore, even if the last person leaving the room, there is remainder one occupant considered by counter that is not leaving due to the previous error even there are no more occupants left inside the laboratory.

Figure 4.7 : Counter show negative value

The second problem is the counter will ignore if a visitor stand in between the sensor or one of them. This means, once occupant stand in between the door, buzzer will beep indicates error, and the occupant have no choice but to step back. If an occupant failed to do so, it will lead to the unreliable of this system to operate properly.

The sensor did not detect the height of occupant accurately. The data varies even the same person pass through the system. It might be inability of IR proximity sensor to detect the actual range of the occupant. This problem may be due to the limit of the range of detection. By doing some analysis, it is concluding that the sensor gives less efficient output to microcontroller when it detects the black and gross surface. An assumption made that the light intensity at the surrounding of the

detection range affect the accuracy of the sensor. To overcome this problem, a bright LED can be placed near to the sensor to give extra light at surrounding of the sensor. In other hand, the error might due to the sensor fail to detect actual position of occupant. For instance, sensor calculates the height of visitor's shoulder or their hands from above.

At the earlier stage, when the program tested by using push button on SK40C, the system function correctly but when all parts combine together, the output is not as desired. Study had been conduct observed that the time interval to be broken between both sensors is too small. This also due to the distance between the two sensors and after a few calibrating and re-tested done, the system can function as proposed. This sensor also needs to be calibrating to obtain the actual output.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

In this chapter, the entire objective achieved is explained in brief. A few suggestions to improve the project is discussed in term of accuracy, stability and extra function in for future development related to this project.

5.2 CONCLUSION

This project was successfully achieved its objective. Counter System using Microcontroller for Visitor was successfully designed and implemented using SK40C and PIC 18F452 as the main controller. The designed system controls the lighting system automatically as desired. Microcontroller is able to differentiate the visitor whether they are entering or exit the room. The system displays the total visitor present in the laboratory and the height of the visitor through LCD. A

programming to count up and down visitor traversing a certain passage or entrance is operating successfully.

5.3 RECOMMENDATIONS FOR FUTURE IMPROVEMENT

For further study about counter system, the system can be improved by solving the problem occurred by distance sensor. Calibration for sensor and bright LED can be used to increase the accuracy of the distance sensor.

In addition, the study on programming to make the system more flexible is required. This system can be upgrade where both sensors can differentiate the direction of occupant after they stand between the sensors that caused an error.
Other than that, the negative value of the system can be eliminating on further works. The systems will never count to negative value even there are error cause by sensor or microcontroller. The failure of the system to detect person coming in or out from the laboratory also can be improved by doing further research and adding new idea.
On further research, the idea to calculate height of visitor also can be upgrade so the system is more reliable and accurate.

Moreover, any idea to design a system that can save power energy in a building would be necessary to reduce power consumption and electricity bill. This can avoid energy wasting when it not in use.

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APPENDIX A

PIC MICROCONTROLLER CODE OF COUNTER SYSTEM USING MICROCONTROLLER FOR VISITOR (SK40C)

```
//Define port
#define sensor1 portb.f0
#define sensor2 portb.f1
#define error portb.f7
#define relay portb.f6

//Define LCD port

sbit LCD_RS at RB4_bit;
sbit LCD_EN at RB5_bit;
sbit LCD_D0 at RD0_bit;
sbit LCD_D1 at RD1_bit;
sbit LCD_D2 at RD2_bit;
sbit LCD_D3 at RD3_bit;
sbit LCD_D4 at RD4_bit;
sbit LCD_D5 at RD5_bit;
sbit LCD_D6 at RD6_bit;
sbit LCD_D7 at RD7_bit;
```

```
sbit LCD_RS_Direction at TRISB4_bit;
sbit LCD_EN_Direction at TRISB5_bit;
sbit LCD_D0_Direction at TRISD0_bit;
sbit LCD_D1_Direction at TRISD1_bit;
sbit LCD_D2_Direction at TRISD2_bit;
sbit LCD_D3_Direction at TRISD3_bit;
sbit LCD_D4_Direction at TRISD4_bit;
sbit LCD_D5_Direction at TRISD5_bit;
sbit LCD_D6_Direction at TRISD6_bit;
sbit LCD_D7_Direction at TRISD7_bit;



void introduction(void);
void displayLCD(int y);
void main() {
int count=0,count1=0,txt[7];
trisb=0b00000011;
trisd=0;

portb=0;
adcon1=0;
lcd_init();
introduction();

 while(1){

        while  (sensor1==0){
        if((sensor1==0)&&(sensor2==0)){error=1;}

            while (count<10){
                if(sensor2==0)
                { count=13;
                  delay_ms(500);
```

```
            if((sensor1==0)&&(sensor2==0)) continue;
            count1++;
            displayLCD(count1);
           }
           else{ delay_ms(50);count++;
           }
                  }
    while((count==10)&&(sensor1==0))
    {error=1;}
    if(sensor1==1){error=0;}



    }
    error=0;
while (sensor2==0){
if((sensor1==0)&&(sensor2==0)){error=1;}

     while (count<10){
          if(sensor1==0){
          count=13;delay_ms(500);
          if((sensor1==0)&&(sensor2==0)) continue;
           count1--;
           displayLCD(count1);
          }
          else{
          delay_ms(50);count++;
          }
    }
    while((count==10)&&(sensor2==0))
    {error=1;}
    if(sensor2==1){error=0;}
```

```
        }
        error=0;

    if(count1>0){relay=1;}
    if(count1==0){
    relay=0;
    }
    count=0;

    if(count1>=5){
            Lcd_Cmd(_LCD_CLEAR);
            Lcd_Cmd(_LCD_CURSOR_OFF);
            Lcd_Out(1,1,"     Full     ");
             Lcd_Out(1,11,"Count:");
            IntToStr(5,txt);
            Lcd_Out(2,5,txt);
            delay_ms(90);
             count1=5;
            }
    else if(count1<0){count1=0;}
}   }
void introduction(void)
{
unsigned char i;

Lcd_Cmd(_LCD_CLEAR);

Lcd_Out(1,1,"     WELCOME     ");
Lcd_Out(2,1,"  SELAMAT DATANG ");
delay_ms(2000);
```

```
for(i=0; i<16; i++) {            // Move text to the left 16 times
     Lcd_Cmd(_LCD_SHIFT_LEFT);
     delay_ms(80);
   }
Lcd_Cmd(_LCD_CLEAR);


}
void displayLCD(int y)
{ char txt[7];

 IntToStr(y,txt);
 Lcd_Cmd(_LCD_CLEAR);
 Lcd_Out(1,1,"Count:");
 Lcd_Out(1,11,txt);
 Lcd_Out(2,11,"per 30");



 }
```

APPENDIX B

PIC MICROCONTROLLER CODE OF COUNTER SYSTEM USING MICROCONTROLLER FOR VISITOR (FULL SYSTEM)

```
//Define port
#define error portb.f7
#define relay portb.f6

//Define LCD port
sbit LCD_RS at RB4_bit;
sbit LCD_EN at RB5_bit;
sbit LCD_D0 at RD0_bit;
sbit LCD_D1 at RD1_bit;
sbit LCD_D2 at RD2_bit;
sbit LCD_D3 at RD3_bit;
sbit LCD_D4 at RD4_bit;
sbit LCD_D5 at RD5_bit;
sbit LCD_D6 at RD6_bit;
sbit LCD_D7 at RD7_bit;

sbit LCD_RS_Direction at TRISB4_bit;
sbit LCD_EN_Direction at TRISB5_bit;
sbit LCD_D0_Direction at TRISD0_bit;
```

```
sbit LCD_D1_Direction at TRISD1_bit;
sbit LCD_D2_Direction at TRISD2_bit;
sbit LCD_D3_Direction at TRISD3_bit;
sbit LCD_D4_Direction at TRISD4_bit;
sbit LCD_D5_Direction at TRISD5_bit;
sbit LCD_D6_Direction at TRISD6_bit;
sbit LCD_D7_Direction at TRISD7_bit;

unsigned long s1_value=0,s2_value=0,s3_value=0;
unsigned long Vout, Range,Range_an,Hight;
int count=0,count1=0,txt[12],txt2[12];
int sensor1=1,sensor2=1;

void readSensor(void);
void readSensor3(void);
void calculateHight(void);
void introduction(void);
void displayLCD(int y);

void main()
{
   TRISB=0b00000000;
   TRISD=0;
   TRISA=0xFF;

   PORTB=0;
   ADC_Init();
   lcd_Init();
   Lcd_cmd(_LCD_CURSOR_OFF);
   introduction();
   displayLCD(count1);
   adcon1=6;
```

```
while(1)
{    readSensor3();
     calculateHight();
      //display hight
      LongToStr(Hight,txt2);
      Lcd_Out(2,15, "cm");
      Lcd_Out(2,4,txt2);
      Lcd_Out(2,1, "Ur Height:");

     readSensor();
     while (sensor1==0)
     {
          readSensor();
          while (count<20)
          {
               readSensor();
               if(sensor2==0)
               {
                  count=23;
                  delay_ms(1000);
                  readSensor();
                  if((sensor1==0)&&(sensor2==0)){error=1; count1--;
                  if ((sensor1==1)&&(sensor2==1))continue; }
                  count1++;
                  displayLCD(count1);

                  //display "Out"
                    Lcd_Out(1,14,"In");
                    delay_ms(500);
                    Lcd_Out(1,14,"   ");

               }
               else
```

```
            {
               delay_ms(50);
               count++;
            }
         }
         readSensor();
        while((count==20)&&(sensor1==0))
        {
            error=1;
            readSensor();
        }
        readSensor();
        if(sensor1==1)
        {error=0;}
    }
    error=0;

readSensor();
while (sensor2==0)
{
    readSensor();
    while (count<20)
    {
        readSensor();
        if(sensor1==0)
        {
          count=23;delay_ms(1000);
          readSensor();
          if((sensor1==0)&&(sensor2==0)){error=1;count1++;
            if ((sensor1==1)&&(sensor2==1))continue; }
          count1--;
          displayLCD(count1);
```

```
                    //display "Out"
                    Lcd_Out(1,14,"Out");
                    delay_ms(500);
                    Lcd_Out(1,14,"    ");
                }
                else
                {
                   delay_ms(50);
                   count++;
                }
             }
            readSensor();
            while((count==20)&&(sensor2==0))
            {
                error=1;
                readSensor();
            }
            if(sensor2==1)
            {error=0;}
          }
          error=0;
          count=0;

        // on/off lamp
        if(count1>0)
          relay=1;
        else
          relay=0;

           if(count1>=200)
        {
            delay_ms(1000);
            displayLCD(count1);
```

```
          Lcd_Out(2,1,"      Full     ");
       }
       if(count1<0) continue;



   }//while(1)
}//main

void introduction(void)
{
    unsigned char i;
    Lcd_Cmd(_LCD_CLEAR);
    Lcd_Out(1,1,"    WELCOME     ");
    Lcd_Out(2,1," SELAMAT DATANG ");
    delay_ms(2000);

    // Move text to the left 16 times
    for(i=0; i<16; i++)
    {
      Lcd_Cmd(_LCD_SHIFT_LEFT);
      delay_ms(250);
    }
    Lcd_Cmd(_LCD_CLEAR);
    Lcd_cmd(_LCD_CURSOR_OFF);
}

void displayLCD(int y)
{
    char txt[7];
    IntToStr(y,txt);
    Lcd_Cmd(_LCD_CLEAR);
    Lcd_Out(1,7,txt);
    Lcd_Out(1,1,"Occupant: ");
```

```
 }

void readSensor(void)
 {
      int j;
      for(j = 0 ; j < 10 ; j++)        // take analog result for 10 times
      {
         s1_value = s1_value + ADC_Read(1);
         s2_value = s2_value + ADC_Read(2);
      }
      s1_value = s1_value/10;       //get average
      s2_value = s2_value/10;

      if (s1_value>95)
        sensor1=0;   //detect object
      else
         sensor1=1;  //no object

     if (s2_value>95)
        sensor2=0;    //detect object
      else
        sensor2=1;    //no object
 }

void readSensor3(void)
 {
      int j;
      for(j = 0 ; j < 10 ; j++)        // take analog result for 10 times
      {
         s3_value = s3_value + ADC_Read(3);
      }
      s3_value = s3_value/10;       //get average
 }
```

```
void calculateHight(void)
 {
      Vout=(s3_value*500000)/1024;

      if ((Vout > 43945)&&(Vout < 279785))      // read only from 0.4V = 80cm  to
2.8V = 8cm
      {
          Range_an=(Vout-19000)/2099;
          Range=1000/Range_an;
          Hight=210-Range;
      }
 }
```